ABSTRACT

~~In a 3D free space micromirror device, a mirror plate is joined with actuators through flexible springs where the other ends of the actuators have fixed support on the substrate. Single crystal silicon and aluminum are used as bi-morph materials with silicon dioxide providing electrical isolation between the two. Thickness variation in the microstructure is achieved by two-step p-n junction formed in a p-type substrate. Thick and thin n-silicon layer formation and DRIE cut mechanisms are employed in such a way that all the thick and thin silicon components of the structure are released simultaneously avoiding overetch which can be detrimental to the thin flexural springs. Working prototypes of the device have been found suitable for any optical switching array architecture where deflections up to 10 degrees are required.~~

First and second n-doped regions are formed at a surface of a p-doped single crystal silicon substrate. An aluminum layer is patterned overlying some of the second n-doped regions to form thermal actuators. A dielectric layer is deposited overlying the patterned aluminum layer and an underlying thermal oxide layer. A metal layer is deposited thereover and patterned to form bond pads to the thermal actuators and to form reflecting mirror surfaces overlying others of the second n-doped regions to form micromirrors. The substrate is etched away from the backside stopping at the first and second n-doped regions. Then the wafer is diced into mirror array chips. Portions of the first n-doped regions are etched away from the frontside to form flexible springs wherein the second n-doped regions covered by the patterned aluminum layer form thermal actuators and wherein the flexible springs connect the micromirrors to the thermal actuators.